P88 Development of an Objective High Spatial Resolution Soil Moisture Index

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1. MOTIVATION

- Flash droughts, flood potential and fire potential are a few of the nowcasting hydrologic challenges for forecasters and decision makers
- Current soil moisture analysis products are not high enough resolution or timely enough for forecasters to use in nowcasting environment
- Relative soil moisture products do not put current analysis into a climatological context
- Objective: Develop a real-time, high-resolution soil moisture index product the provides climatological context for to aid decision makers with the following features:
  - sub-county spatial resolution
  - produced daily; available same day
  - displayable in forecaster decision support tools to enable overlay of other variables (e.g., forecast precipitation, lightning, etc.)

2. LAND INFORMATION SYSTEM (LIS) CLIMATOLOGY

- SPoRT runs the Noah Land Surface Model (LSM) in uncoupled/analysis mode to produce real-time, daily land surface output
- These real-time, daily runs are then compared to a 30+ year climatology (1 January 1981 to 31 December 2013)
  - CONUS+ domain at 0.03-deg resolution (~3 km)
  - IGBP/MODIS 20-class land use, STATSGO 16-class soil
  - MODIS/FPAR 30-sec resolution monthly GVF climatology (Wang et al. 2014; Barlage, personal communication)
  - Atmospheric forcing: NARR-based NLDAS-2 hourly data
  - 30+ year spin-up (1979-2010), then re-ran for 1979-2013 (only >1981 used in climatology) to ensure deep soil equilibrium
  - Output soil fields once daily
- Histograms of the 33-year climatology are created for all grid points in each county in the conterminous United States (CONUS; Fig. 1)
- Each percentile is matched to a U.S. Drought Monitor category using technique developed in Xia et al. (2013)

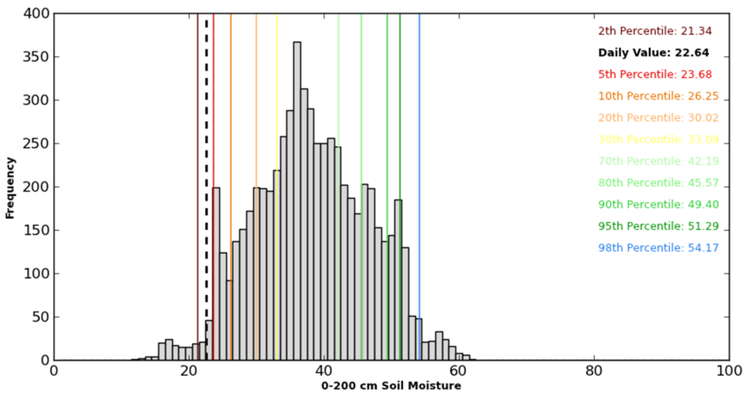

Figure 1. Histogram for Madison County, AL for 21 August. Vertical colored lines denote each USDM category (yellows/reds) and reverse categorization for flooding (greens/blues). Dashed line represented average countywide soil moisture for 21 August 2007.

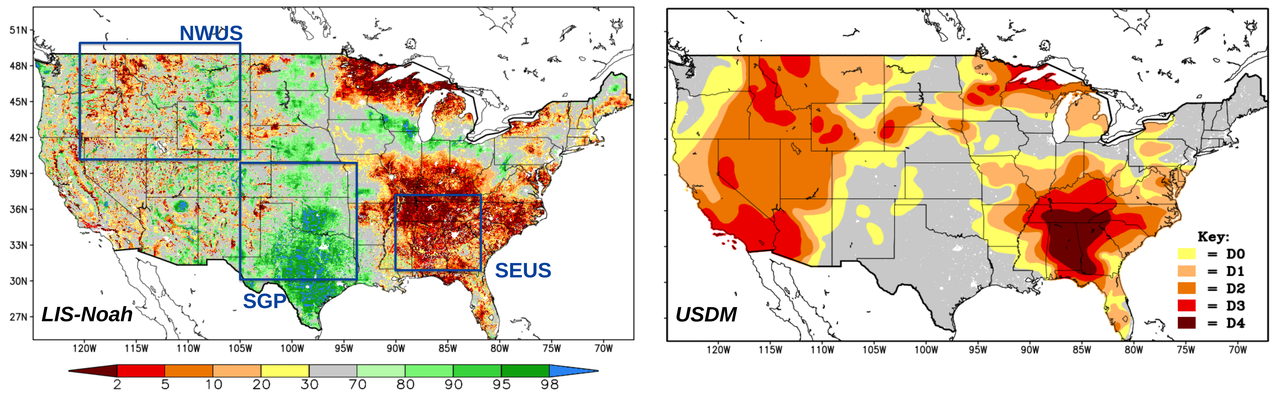

Figure 2. Qualitative comparison between LIS-Noah percentile product (left) and USDM (right) for 21 August 2007. Blue boxes denote validation regions shown in Fig. 3 and Tables 1 and 2.

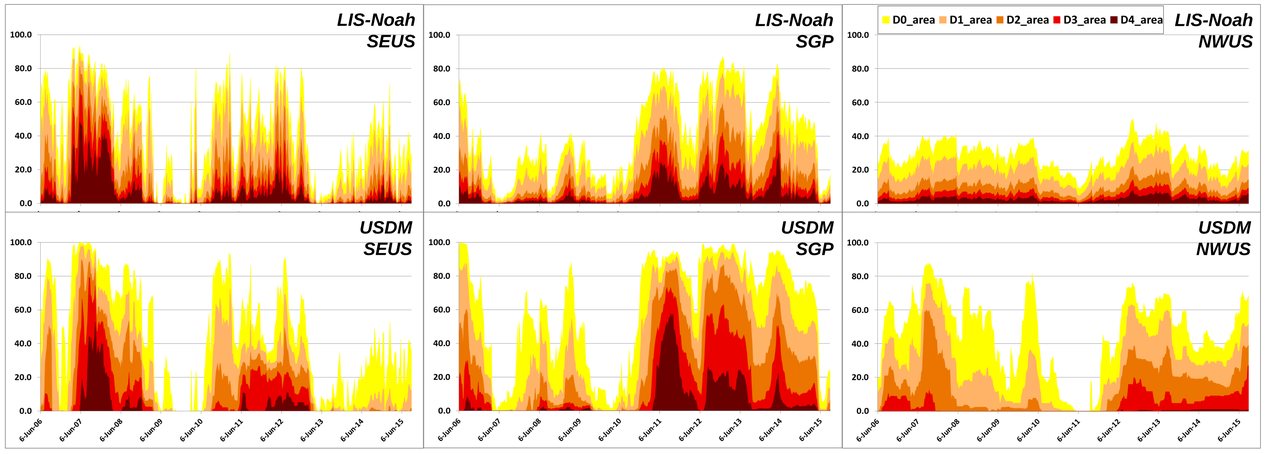

Figure 3. Time series of bulk area comparison between LIS-Noah (top row) and USDM (bottom row) for three geographical areas shown in Fig. 2 from June 2006 through June 2015.

Table 1. Difference in mean area (LIS-Noah minus USDM) for each region from June 2006 to Sept. 2015

Bias	D0	D1	D2	D3	D4
SEUS	-4.1	2.1	0.2	0.7	2.4
SGP	-19.8	-14.0	-12.5	-6.6	-1.2
NWUS	-17.4	-8.6	-4.5	1.4	2.6

Table 2. Pearson's correlation for each region from June 2006 to Sept. 2015

Correlation	D0	D1	D2	D3	D4
SEUS	0.89	0.87	0.85	0.83	0.72
SGP	0.90	0.90	0.88	0.83	0.70
NWUS	0.77	0.68	0.53	0.38	0.12

REFERENCES

Wang, W. and Coauthors, 2014: "WRF v3.5 User's Guide", National Centers for Atmospheric Research [Available online at: http://www2.mmm.ucar.edu/wrf/users/docs/user_guide_V3.5/contents.html].

Xia, Y. and Coauthors, 2013: "Validation of Noah-Simulated Soil Temperature in the North American Land Data Assimilation System Phase 2", *J. Appl. Meteor. And Climo.*,**52**, 455-471.

3. PERCENTILE PRODUCT

- Each grid point in the real-time, daily LIS-Noah run is compared to its daily county histogram to create gridded percentile product
- Generally good comparison east of the Rockies; challenges in western U.S. (Fig. 2)
- LIS-Noah also highlights TS Erin impacts over Texas and Oklahoma
- Available in AWIPS 2 for select SEUS NWS WFOs

4. COMPARISON TO USDM

- USDM shapefiles were rasterized and mapped to the LIS-Noah grid for statistical comparison
- Generally captures the overall magnitude of total drought area (Fig. 3)
- Captures major droughts (SEUS in 2007; SGP in 2011 and 2012)
- SEUS is noisier given the more frequent and scattered nature of precipitation
- Northwest is not as well represented because factors defining drought are driven by groundwater and snowmelt
- Best overall statistics in SEUS domain
- Bias depicts overall under-representation of lower drought categories and slight over-representation of higher drought categories (Table 1)
- Correlations are highest for lower drought categories and SEUS/SGP; correlations diminish for higher drought categories and NWUS region (Table 2)

5. FUTURE WORK

- Formal assessment of percentile product scheduled for spring/summer with SEUS WFOs
- Investigate incorporation of snow water equivalent information into percentile calculations to improve relatively poor statistics in the west
- Quantitative comparison of wet categories against USGS stream gauges flooding reports